Warm-Up!

1. What are the dimensions of the given matrix?

$$\begin{bmatrix} 5 & 3 & 4 \\ 6 & 1 & -8 \end{bmatrix}$$ 2x3

2. Solve the equation.

$$\begin{bmatrix} 4x & 2y \\ 6z+1 & 12 \end{bmatrix} = \begin{bmatrix} 14 & 16.8 \\ 19 & 12 \end{bmatrix}$$ 4x = 14, x = 3.5, y = 8.4, z = 3

3. Identify each matrix with as many of the following descriptions that apply: row matrix, column matrix, square matrix, and/or zero matrix.

a. $\begin{bmatrix} 1 & 2 & 5 & 4 \end{bmatrix}$ Row Matrix

b. $\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ Column, Zero

c. $\begin{bmatrix} 0 \end{bmatrix}$ Zero, Square, Row, Column

d. $\begin{bmatrix} 1 & -5 \\ 0 & 3 \end{bmatrix}$ Square

4-2 Operations with Matrices
4-3 Multiplying Matrices

Norcom is a company that runs 3 factories to produce their 4 most popular products.

During the first week of the month, their output, measured in units, is as follows:

	Product 1	Product 2	Product 3	Product 4
Factory 1	6	3	2	0
Factory 2	0	4	8	5
Factory 3	4	2	1	0

Put the following data into a matrix.

$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix}$$

During the second week of the month, their production schedule changes and their output, measured in units, is as follows:

	Product 1	Product 2	Product 3	Product 4
Factory 1	3	3	0	1
Factory 2	0	6	5	2
Factory 3	10	2	0	1

Put the following data into a matrix.

$$B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

What is the total production for each product at each factory after 2 weeks? (express in a matrix)

$$A + B = \begin{bmatrix} 9 & 6 & 2 & 1 \\ 0 & 10 & 13 & 7 \\ 14 & 4 & 1 & 1 \end{bmatrix}$$

Matrix addition and subtraction

- matrices must have the same dimensions
- each element is added/subtracted to the element in its corresponding location

$$A=\begin{bmatrix}6 & 3 & 2 & 0\\ 0 & 4 & 8 & 5\\ 4 & 2 & 1 & 0\end{bmatrix} \quad B=\begin{bmatrix}3 & 3 & 0 & 1\\ 0 & 6 & 5 & 2\\ 10 & 2 & 0 & 1\end{bmatrix}$$

Suppose Norcom needs to meet a large order, how much production would they have if, during the second week, they are open twice as long? (express in a matrix)

$$A+2B = \begin{bmatrix}12 & 9 & 2 & 2\\ 0 & 16 & 18 & 9\\ 24 & 6 & 1 & 2\end{bmatrix}$$

$$2B=\begin{bmatrix}6 & 6 & 0 & 2\\ 0 & 12 & 10 & 4\\ 20 & 4 & 0 & 2\end{bmatrix}$$

Scalar Multiplication

- multiplying every element by the same value

$$2\cdot\begin{bmatrix}2 & 1 & 4\end{bmatrix} = \begin{bmatrix}4 & 2 & 8\end{bmatrix}$$

Matrix Multiplication

- If AxB, then # columns for A = # rows for B
- If A_{mxn} x B_{nxr} , then AB_{mxr}
- Every element in a row from A is multiplied by every element in a column from B and then added together

$A_{3x2} \cdot B_{2x5} = AB_{3x5}$

$C_{4x8} \cdot D_{8x7} = CD_{4x7}$

Example:

$$C=\begin{bmatrix}5 & 4 & 8\\ -2 & 0 & 1\end{bmatrix} \quad D=\begin{bmatrix}-2 & 0\\ 6 & 4\\ 1 & -3\end{bmatrix}$$

2x3 · 3x2 = $C \cdot D_{2x2}$

(1,1) $5(-2)+4(6)+8(1)=22$ (−10, 24, 8)

(1,2) $5(0)+4(4)+8(-3)=-8$ (6, −24)

(2,1) $-2(-2)+0(6)+1(1)=5$

(2,2) $-2(6)+0(4)+1(-3)=-3$

$$\begin{bmatrix}1,1 & 1,2\\ 2,1 & 2,2\end{bmatrix} = \begin{bmatrix}22 & -8\\ 5 & -3\end{bmatrix}$$

ex:

$$E=\begin{bmatrix}7\\ 3\end{bmatrix} \quad F=\begin{bmatrix}1 & 5\\ -3 & 2\\ 0 & 1\\ 4 & -2\end{bmatrix}$$

2x1, 4x2

$E \cdot F$ = Cannot be done

$F \cdot E_{4x1}$

(1,1) $1(7)+5(3)=22$

(2,1) $-3(7)+2(3)=-15$

(3,1) $0(7)+1(3)=3$

(4,1) $4(7)+2(3)=22$

$$E=\begin{bmatrix}7\\ 3\end{bmatrix} \quad \begin{bmatrix}1,1\\ 2,1\\ 3,1\\ 4,1\end{bmatrix} = \begin{bmatrix}22\\ -15\\ 3\\ 22\end{bmatrix}$$

Suppose the profit for each unit of products 1-4 is: 3, 10, 7, and 2 respectively.

What would be the total profit for each factory during the first week?

$$A_{3\times4}=\begin{bmatrix}6&3&2&0\\0&4&8&5\\4&2&1&0\end{bmatrix} \quad P_{4\times1}=\begin{bmatrix}3\\10\\7\\2\end{bmatrix}$$

$$=\begin{bmatrix}62\\106\\39\end{bmatrix} \quad AP_{3\times1}=\begin{bmatrix}1,1\\2,1\\3,1\end{bmatrix}$$

Suppose the volume for each unit of products 1-4 is: 8, 5, 1, and 4 respectively.

What would be the total storage space used for each factory during the first week?

$$A_{3\times4}=\begin{bmatrix}6&3&2&0\\0&4&8&5\\4&2&1&0\end{bmatrix} \quad V_{4\times1}=\begin{bmatrix}8\\5\\1\\4\end{bmatrix}$$

If the the manager wanted to combine those calculations, she can as follows:

$$A=\begin{bmatrix}6&3&2&0\\0&4&8&5\\4&2&1&0\end{bmatrix} \quad W=\begin{bmatrix}3&8\\10&5\\7&1\\2&4\end{bmatrix}$$

3x4 4x2

Calculator

Homework:
p.164
14, 15, 25, 27
p172-173
13-20(hand), 31-34, 36- 39